U.S. Fish & Wildlife Service

Recovery Plan for

Cordia bellonis

U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

RECOVERY PLAN

for

CORDIA BELLONIS

Prepared by

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for the

U.S. Fish and Wildlife Service
Southeast Region
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Approved: Sam D. Hamilton
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Date: 10-1-99

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By approving this recovery plan, the Regional Director certifies that the data used in its development represent the best scientific and commercial information available at the time it was written. Copies of all documents reviewed in the development of the plan are available in the administrative record, located at the Boquerón Field Office in Boquerón, Puerto Rico.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1999. Recovery Plan for *Cordia bellonis.* Atlanta, Georgia. 18 pp.

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5430 Grosvenor Lane, Suite 110
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EXECUTIVE SUMMARY

Current Status: *Cordia bellonis*, currently listed as endangered, is a shrub species endemic to the island of Puerto Rico. It is known from only three public forests: Maricao, Susúa, and Río Abajo. Only 81 individuals of *Cordia bellonis* are known to occur in the wild.

Habitat Requirements and Limiting Factors: *Cordia bellonis* has been found at Maricao and Susúa in serpentine soils, at road edges, river margins, and on steep slopes at an elevation between 230 to250 meters (754 to 820 feet) (Susúa) and 441 to 820 meters (1,447 to 2,690 feet) (Maricao). In the Río Abajo Forest, the species was found either on sunny banks along dirt roads, growing in thickets of vegetation, or in open saddles between limestone hills. The species is threatened by habitat destruction and modification, certain forest management practices, and its restricted distribution. The rarity and restricted distribution of this species make it vulnerable to habitat destruction and modification.

Recovery Objective: Delisting.

Recovery Criteria: *Cordia bellonis* will be considered for delisting when the following criteria are met: (1) a management plan that considers the protection and recovery of the species has been prepared and implemented for the Maricao, Susúa and Río Abajo Commonwealth Forests and (2) new populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas. One of these populations should be established using the 111 individuals already located at the Cambalache greenhouse.

Actions Needed:

1. Protect the existing populations and its habitat through the development and implementation of a management plan for the Maricao, Susúa and Río Abajo Commonwealth Forests.
2. Monitor known populations.
3. Enforce existing Commonwealth and Federal endangered species regulations.
4. Reintroduce transplanted individuals.
5. Educate the public on conservation values and regulations.
6. Search for additional populations and potential habitat suitable for reintroduction efforts.
7. Conduct research on the life history of the species and evaluate propagation techniques.
8. Conduct propagation and enhance existing populations and establish new ones on protected lands.

9. Annually assess the overall success of the recovery program and recommend actions.

Date of Recovery: Delisting should be initiated in 2025, if recovery criteria are met.

Recovery Costs: Recovery costs for *Cordia bellonis* have been estimated at $80,000 for the first three years. Subsequent expenditures will depend upon the results of these preliminary surveys and studies to be conducted during the initial three years, and therefore, cannot be estimated at this time.

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PART I. INTRODUCTION

Cordia bellonis is a shrub species endemic to the island of Puerto Rico. It is currently restricted to three public forests: Maricao, Susúa, and Río Abajo (Figure 1). The species is threatened by habitat loss and modification, certain forest management practices, and its restricted distribution.

This species was determined to be an endangered species on January 10, 1997, under the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1997). Critical habitat has not been designated for this species because of the risk of vandalism, as well as its potential for overcollection.

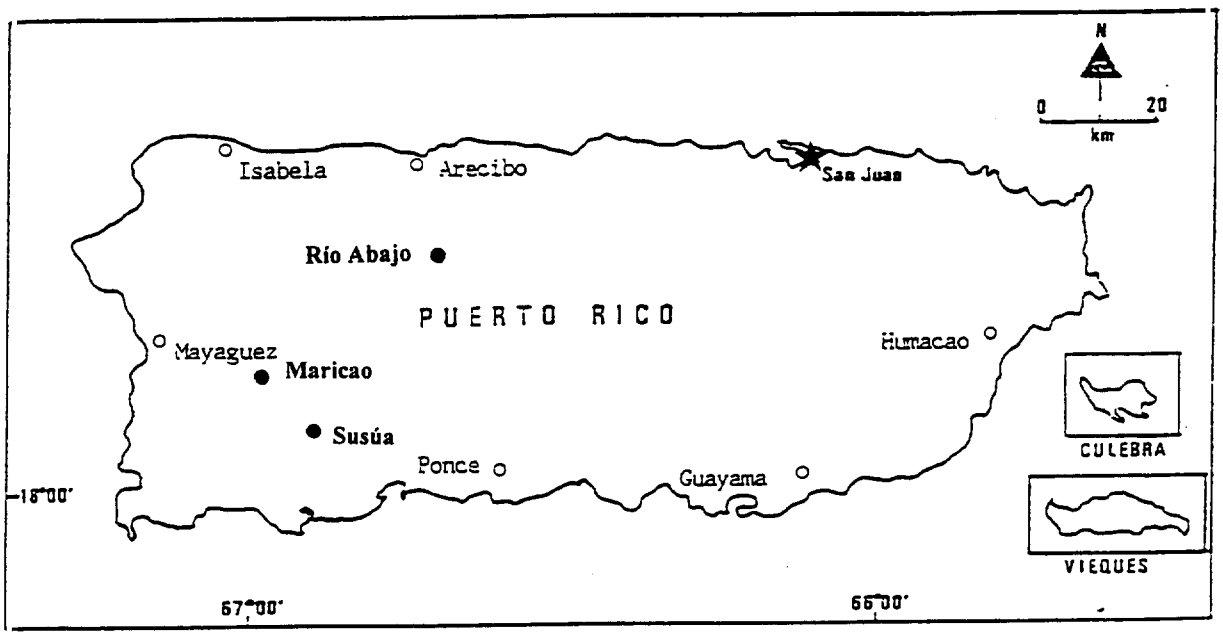
Description

Cordia L. is a genus of about 250 or more species of trees and shrubs of tropical and subtropical regions (Breckon and Kolterman 1993). Of the fifteen native species, four (*C. bellonis* Urban, *C. borinquensis* Urban, *C. rupicola* Urban, and *C. wagnerorum* Howard) are endemic to Puerto Rico and one (C. *rickseckeri* Millsp.) is restricted to Puerto Rico and the Virgin Islands (Breckon and Kolterman 1993). *Cordia bellonis* was described by Urban (1899). Britton and Wilson (1925) described this species as a member of *Varronia*.

Cordia bellonis is an arching to erect shrub of about 1 to 2 meters (3.3 to 6.6 feet) high with very slender twigs with short hairs. The leaves are alternate, oblong to oblong-lanceolate, 2 to 6 centimeters (0.8 to 2.4 inches) long, usually 2.5 to 3 times longer than wide. The corolla is white with 4 subcylindric lobes. The fruit is a pointed drupe, 5 millimeters (0.2 inches) in length (Proctor 1991). The white axillary flowers are unisexual and the plants are either male or female (dioecious) (Breckon and Kolterman 1993). The flowers have a thin, reduced corolla that is adnate at its apex to the apical rim of the calyx. Breckon and Kolterman (1993) specified that all other species of the genus apparently have bisexual flowers. The plants remain dense and shrubby in open, exposed habitats, but in closed vegetation the branches become divaricating and form obtuse angles that hook the plant into the surrounding trees, forming a clambering, rigidly branched liana (Breckon and Kolterman 1993).

Distribution and Abundance

Cordia bellonis was first described by Urban (1899) from specimens collected by Paul Sintenis at "Monte Alegrillo" in the municipality of Maricao, Puerto Rico. The name of "Monte Alegrillo" has disappeared from use, but according to Proctor (1991), N.L. Britton referred to "Monte Alegrillo" as the peak at the extreme head of the Río Maricao, with an elevation of 900 meters (2952 feet). This type location was developed for the installation of telecommunication towers. Paul Sintenis collected *Cordia bellonis* in the



(Figure 1) Location of *Cordia bellonis* (●) in the Maricao , Susúa, and Río Abajo Commonwealth Forests in Puerto Rico.

area known as Indiera Fría. The species was also collected by Britton and Brown in 1915 from Monte Cerrote near Adjuntas (Proctor 1991). Britton and Wilson (1925) described the species as *Varronia bellonis* and identified its distribution as mountain-sides in the vicinity of Maricao. Liogier and Martorell (1982) stated that the species distribution was the mountain slopes and serpentine hills in northwestern districts of Puerto Rico.

Maricao Commonwealth Forest

Proctor (1991) reported only 4 individuals of *Cordia bellonis* from Caín Alto Ward in the Maricao Commonwealth Forest. Breckon and Kolterman (1993) reported 87 individuals at 17 localities in three areas in Maricao. Half of the localities consisted of isolated individuals. In January 1995, one immature plant of *Cordia bellonis* was located on a private property, along a dirt road off Highway 119 (Breckon and Kolterman 1996).

Susúa Commonwealth Forest

The species was reported for the first time in Susúa in 1992, where a small population of 5 individuals was found (Breckon and Kolterman 1993).

Río Abajo Commonwealth Forest

Cordia bellonis was also unknown from the Río Abajo Commonwealth Forest until 1994 (Federal Highway Administration and Puerto Rico Highway and Transportation Authority 1994). Approximately 118 individuals were found in 12 localities. Ninety-five (82 percent) of these individuals were removed for possible future reintroduction because of the construction of the road PR 10 (Puerto Rico Highway and Transportation Authority 1995). To date, 111 individual plants are located at Cambalache Department of Natural and Environmental Resources' nursery under the custody of Department personnel. No reintroduction plan for this species has been prepared. An eight-feet (2.4 meters) tall individual of *Cordia bellonis* was observed east of highway PR10.

Habitat Description

Cordia bellonis has been found at Maricao and Susúa in serpentine soils, at road edges, river margins, and on steep slopes at an elevation between 230 to 250 meters (752 to 817 feet, Susúa) and 441 to 820 meters (1,442 to 2,681 feet, Maricao) (Breckon and Kolterman 1993). In the Río Abajo Forest, the species was found on sunny banks along dirt roads, growing in thickets of vegetation, and in open saddles between limestone hills (Federal Highway Administration and Puerto Rico Highway and Transportation Authority 1994).

The Maricao Commonwealth Forest falls within three life zones: subtropical wet forest; subtropical moist forest, and subtropical lower montane wet forest. The Susúa

Commonwealth Forest is found within the subtropical moist forest life zone, the most extensive life zone found on the island (Ewel and Whitmore 1973). The majority of the area of these forests is covered by serpentine outcrops interspersed with Nipe and Rosario clay soils, the products of the weathering of serpentine rock. These areas have a poor water-holding capacity, therefore the vegetation is more xeric than might be expected based on the rainfall received in the region. Topography is mountainous, characterized by steep ravines and intermittent streams.

Mean annual precipitation at Maricao Fish Hatchery (elevation 457 meters (1499 feet)), was reported to be 2,466 millimeters (97 inches), with a dry period occurring from December to March. The mean annual temperature in Maricao was 21.7°C (71.1°F), with a range of 20.2°C (68.4°F) in January to 23.0°C (73.4°F) in August. Mean annual precipitation near the Susúa Commonwealth Forest has been reported to be 1,339 millimeters (53 inches) with a dry season occurring from January to March and a wetter period from July to November (Silander *et al.* 1986). Associated species of the Susúa population include *Buchenavia capitata, Clusia rosea, Pimenta racemosa* var. *grisea, Swietenia mahogani* (saplings), *Allophyllus crassinervis, Comocladia glabra, Neolaugeria resinosa, Rondeletia inermis*, and *Tabebuia haemantha*, with *Pitcairnia angustifolia* in the understory (Breckon and Kolterman 1993).

Although the larger portion of the Río Abajo Commonwealth Forest falls within the subtropical wet forest, a small portion of subtropical moist forest has been mapped in the northeastern extreme of the forest (Ewel and Whitmore 1973). The Río Abajo Commonwealth Forest is located in the humid region of the northern limestone hills receiving an average of 2,606 millimeters (102 inches) of precipitation annually. The most rain falls in May and October with decreased amounts of precipitation in June and July. Mean monthly temperature is 25.5°C (77.9°F) (Silander *et al.* 1986).

Reproductive Biology

The species of *Cordia* typically have perfect (bisexual) flowers, and some species exhibit heterostyly; meaning that some plants produce flowers with short styles and long stamens, while other plants produce flowers with long styles and short stamens (Breckon and Kolterman 1993). These authors established that this condition favors outcrossing.

Breckon and Kolterman (1993) observed that some plants bore structures that appeared to be buds, aborted fruits, or galls. From October through January, they observed these structures when other plants in the population were mostly in flower, mostly in fruit, or mostly sterile. In Susúa, they observed that the small flowers appeared to fade over the course of the morning; perhaps because they were pollinated in the evening or at night. Honeybees (*Apis mellifera*) and other insects were observed visiting the flowers on plants in Maricao. These authors reported asexual reproduction in the wild, some stems creep along the ground or under the leaf litter, and some of these were observed producing

roots. Breckon and Kolterman (1996) grew 26 plants from seeds collected in Maricao. In November, 23 to 27 percent of the plants were in flower. The sex ratio estimated for the cultivated plants was 7 females to 4 males.

Reasons for Listing

Cordia bellonis was listed as endangered in 1997. Destruction and modification of the habitat are considered to be the most significant factors affecting the numbers and distribution of *Cordia bellonis*. This species is only known from three areas in Puerto Rico; Maricao, Susúa, and Río Abajo. The species' rarity and restricted distribution make it vulnerable to habitat destruction and modification and certain forest management practices.

In Maricao, the species is found at 17 localities in three areas, with a total of 87 individuals. Thirty-four of these individuals were eliminated due to clearing along the roadside and the reconstruction of Road 362. Half of the localities consist of isolated individuals. Because the majority of these individuals occur along both sides of two public roads, maintenance of road sides, as well as fires and vandalism, may result in the loss of these individuals.

In Susúa, a small population of only 5 individuals was found in 1992. The species was previously unknown from this area. This small population may be affected by certain forest management practices.

Cordia bellonis was also unknown from the Río Abajo forest until 1994. Approximately 118 individuals were found in 12 localities. Ninety-five individuals were located along the construction route for a highway (which is now completed) and were removed for possible future transplantation. Of the remaining 23 individuals, 13 have been found in an area designated for compensation (mitigation) for the highway and 10 are found in highway rights-of-way. The species is also known from a private landholding where extraction of fill material for the construction of the road will likely result in the loss of these plants.

As a dioecious plant, *Cordia bellonis* requires outcrossing to successfully reproduce. Being dioecious creates a limiting factor affecting the continued existence of this rare plant since most remaining individuals are widely separated from each other and, therefore, unlikely to reproduce.

The rarity of this plant makes the species vulnerable to the loss of any individual. Only 81 individuals of *Cordia bellonis* are known to occur in the wild. Habitat modification may dramatically affect this endemic plant.

Conservation Measures

Conservation measures provided to federally listed species include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, State, and private groups and individuals. The Endangered Species Act provides for possible land acquisition in cooperation with the States and requires that recovery actions be carried out for all listed species. Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is listed as federally endangered or threatened. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Fish and Wildlife Service.

Studies of the distribution, abundance, population size and structure, and reproductive biology of *Cordia bellonis* have been ongoing since 1993. These studies have provided information on the threats to the species. Preliminary results from these studies have been incorporated into this recovery plan.

Summary of Comments Received

Copies of the Technical/Agency Draft Recovery Plan for *Cordia bellonis* were sent to 9 reviewers, including three independent peer reviewers, for review and comments. A notice of availability of the Technical/Agency Draft was published in the *Federal Register* on September 11, 1998 (63 FR 48751). No letters of comments were received.

Recovery Strategy

The Service plans to address recovery of this species through the prevention of further habitat loss and population decline, gathering information on the distribution and abundance of the species, conducting research, and establishing new populations in protected habitat.

PART II. RECOVERY

A. Recovery Objective and Criteria

The objective of this recovery plan is to provide direction for reversing the decline of *Cordia bellonis* and for restoring the species to a self-sustaining status, thereby permitting it to be removed from the Federal Endangered Species List.

Cordia bellonis will be considered for delisting when (1) a management plan that considers the protection and recovery of the species has been prepared and implemented for the Maricao, Susúa and Río Abajo Commonwealth Forests and (2) new populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas. One of these populations should be established using the 111 individuals already located at the Cambalache greenhouse. These are minimum requirements, and could be expanded upon if the regenerative or propagative potential of natural and *ex situ* populations proves to be insufficient. Alternatively, if new populations of the species are discovered, it may be preferable to place greater emphasis on protection rather than on propagation in order to achieve the minimum number of plants necessary for recovery.

B. **Narrative Outline**

1. Prevent further habitat loss and population decline. Protection of habitat and individual plants at the known population sites should be initiated by appropriate public agencies.

   11. Protect habitat. The protection of the existing populations should be given the highest priority.

      111. Develop management plans, which provide for the protection and recovery of *Cordia bellonis*, for the Maricao, Susúa and Río Abajo Commonwealth Forests. Management plans should be developed that include measures to protect known individuals and their habitat and provide for long-term monitoring of their growth and reproduction.

   12. Protect and monitor plants. Individual plants and the recruitment of new individuals must be monitored on a long-term basis.

      121. Monitor known populations. Individual plants should be measured and marked. Basic field observations that will contribute to the information available on the population (including phenology, seed production, seed dispersal, recruitment success, site changes, and growth), should be made at regular intervals.

      122. Enforce existing Commonwealth and Federal endangered species regulations. The Commonwealth Department of Natural Resources' Regulation to Govern the Management of Threatened and Endangered Species of 1985 provides for criminal penalties for the illegal take of listed plant species on public land. In addition, development projects that occur in these areas are often funded through local or Federal agencies or require local permits. The Regulation's Section 10 provides for consultations on endangered species that may be affected by a particular project similar to Section 7 of the Endangered Species Act. Section 7 of the Endangered Species Act would apply where Federal lands or federally funded or permitted projects are involved.

123. Educate the public on plant conservation values and regulations. *Cordia bellonis* should be included in the illustrated brochure and slide presentation (in both English and Spanish) on endangered plants and plant communities that are presented to local school groups, organizations, and agencies. Permitting and funding agencies (those potentially involved in Section 7 consultations) should be made aware of endangered plants, the pertinent laws, and their responsibilities.

13. Reintroduce transplanted individuals. A total of 111 individuals were temporarily transplanted to a greenhouse at the Cambalache Forest for propagation trial and strengthening. Ninety five of these individuals were removed from Río Abajo Forest for the construction of a highway. These individuals should be reintroduced in a protected area.

2. Continue to gather information on the distribution and abundance of *Cordia bellonis*. Future management decisions and the establishment of recovery priorities depend on obtaining additional information concerning the distribution and abundance of this species.

21. Search for new populations. Searches for new individuals and populations should be conducted in the Maricao, Susúa, and Río Abajo Commonwealth Forests.

211. Identify and inventory potential sites. Based on a characterization of known habitat types, potential population sites should be identified and searched. The species' known habitat is limited in extent, therefore facilitating searches.

212. Characterize sites to determine their suitability as future recovery sites. If new populations are discovered, this information should be added to the database of the various agencies and organizations involved. In addition, newly discovered sites should be evaluated for the availability of propagative material and the potential for protection.

3. Conduct research. While some studies have been initiated, relatively little biological information is available on *Cordia bellonis*. Studies should focus on those aspects of life history that may be critical to the recovery of the species.

31. Define habitat requirements. Information available from existing studies should be evaluated to more clearly define habitat requirements.

32. Study reproductive biology and ecology of *Cordia bellonis*. Effective management and recovery of this species depends upon obtaining this information.

    321. Assess periodicity of flowering. Studies to determine the frequency, timing, and abundance of flowering; pollination mechanisms; and the physical and biological factors controlling these events should be continued.

    322. Assess seed production and dispersal. Agents of seed predation and/or dispersal should be identified.

    323. Evaluate seed viability and germination requirements. Information on the environmental conditions required for germination should be obtained through field and laboratory studies.

    324. Evaluate requirements for establishment and growth. Field and laboratory experiments should focus on this critical stage to determine the factors that affect establishment and survival.

    325. Determine genetic structure of the species. Continue to study intra and inter-population genetic diversity of the species using appropriate techniques.

33. Evaluate techniques for artificial propagation and develop propagation program. Propagation techniques should be evaluated so that a propagation program with local nurseries may be developed.

    331. Assess methods of propagation. Based on the availability of propagative material, economic and logistical considerations, and results from the above research, determine the most feasible method of propagation and transplantation to existing or new sites. Sexual vs. asexual reproduction should be evaluated as alternatives.

    332. Develop artificial propagation program. This species

should be included in the ongoing artificial propagation program at local nurseries (e.g., the Department of Natural and Environmental Resources).

4. Establish new populations. Areas for the establishment of new populations of *Cordia bellonis* should be selected and new populations established.

   41. Select appropriate sites for population introduction or enhancement using artificially propagated material. Habitat requirements must be considered in order to ensure the success and relevance of transplanting propagated material.

      411. Select sites and assess habitat suitability. Using information from Task 31, inventory potential sites for the introduction and establishment of new populations of *Cordia bellonis*. Consideration should be given to the introduction of this species in other areas of the Maricao Commonwealth Forest, the Susua Commonweatlh Forest, or in the Río Abajo Commonwealth Forest.

      412. Ensure site protection. If proposed sites are not already on protected land, steps must be taken to provide for their protection. Management plans for these new sites should be developed or modified to include consideration for this species.

      413. Introduce and monitor plants. Success of plantings should be carefully monitored.

5. Refine recovery criteria. As additional information on the biology, ecology, propagation, and management of *Cordia bellonis* is accumulated, it will be necessary to better define, and possibly modify, recovery criteria.

   51. Determine number of individuals and populations necessary to ensure species stability and self-perpetuation. Environmental and reproductive studies, together with the relative success of population protection measures, will allow more precise and realistic recovery criteria to be established.

   52. Determine what additional actions, if any, are necessary to achieve recovery criteria. If there are any actions not included in this recovery plan which during the recovery process become recognized needs, they should be incorporated into the plan.

C. **Literature Cited and References**

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PART III. IMPLEMENTATION SCHEDULE

Priorities in column 1 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

List of Abbreviations

DNER - Puerto Rico Department of Natural and Environmental Resources
ES - Fish and Wildlife Service, Ecological Services
LE - Fish and Wildlife Service, Law Enforcement Division
BotGar - Botanical Gardens
Univ. - Universities

IMPLEMENTATION SCHEDULE

Task Priority	Task Description	Task Number	Task Duration (Years)	Responsible Organization FWS R4	Responsible Organization Other	Cost Estimates ($000) FY1	FY2	FY 3	Comments
1	Develop management plans, which provide for the protection and recovery of *Cordia bellonis*, for the Maricao, Susúa and Río Abajo Commonwealth Forests.	111	2	ES	DNER				No cost anticipated.
1	Monitor known populations.	121	Cont.	ES	DNER	3	3	3	
1	Enforce existing Commonwealth and Federal endangered species regulations.	122	Cont.	ES, LE	DNER	6	6	6	
1	Reintroduce transplanted individuals.	13	Cont.	ES	DNER				
2	Educate the public on plant conservation values and regulations.	123	Cont.	ES, LE	DNER	1	1	1	
2	Identify and inventory potential sites.	211	2-4	ES	DNER	3	3	3	
2	Characterize sites to determine their suitability as future recovery sites.	212	2-4	ES	DNER, Univ.				
2	Define habitat requirements.	31	2-4	ES	DNER, Univ.	3	3	3	
2	Assess periodicity of flowering.	321	2-4	ES	DNER, DPNR, Univ.	6	6	6	6K/year includes 321, 322, 323, 324, and 325.

Task Priority	Task Description	Task Number	Task Duration (Years)	Responsible Organization FWS R4	Responsible Organization Other	Cost Estimates ($000) FY1	FY2	FY 3	Comments
2	Assess seed production and dispersal.	322	2-4	ES	DNER, Univ.				
2	Evaluate seed viability and germination requirements.	323	2-4	ES	DNER, Univ.				
2	Evaluate requirements for establishment and growth.	324	2-4	ES	DNER, Univ.				
2	Determine genetic structure of the species.	325	2-4	ES	DNER, Univ.				
2	Assess methods of propagation.	331	2-4	ES	DNER, Univ. BotGar.	2	2	2	
2	Develop artificial propagation program.	332	Cont.	ES	DNER, Univ. BotGar.	2	2	2	
2	Select sites and assess habitat suitability.	411	2-4	ES	DNER, Univ.		2		
2	Ensure site protection.	412	2-4	ES	DNER,				
2	Introduction of plants.	413	2-4	ES	DNER				
2	Determine number of individuals and populations to ensure stability and self-perpetuation.	51	Cont.	ES	DNER, Univ.				
2	Determine what additional actions are needed to achieve recovery criteria.	52	Cont.	ES	DNER, Univ.				

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